


CHROMATOTEC

Expert in Gas Analysis & Air Monitoring

DRIVER MODBUS/JBUS TRAINING

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COMMUNICATION PROTOCOLS

- Considering PC networks and telecommunications, a **communication protocol** is defined to be a specification of several rules dedicated to a specific communication type.
- Initially, a protocol was defined as a set of rules used to communicate on a same « abstraction level » between two different machines. By extension we also use today this word to talk about the communication rules between two abstraction levels on a same instrument.
The mostly used protocol is the network one.

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DEFINITION : MODBUS

- **Modbus** and **Jbus** are *communication protocols* used for *programmable automatons* networks. They are working on Master / Slave mode. They are made up of frames containing the selected automaton address, the action to be done, *function*, (writing, reading), the data and the error check code called CCR or CRC(control of cyclic redundancy).
- The *Modbus* protocol (**Modicon trade mark**) and the *Jbus* one (**April trade mark**) are dialogue protocols based on a hierarchical structure between a master and several slaves.

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OVERVIEW


There are two ways to communicate :

1. The Master talks to the Slave and waits for an answer.
2. The master talks to all the slaves without waiting any answer (general broadcasting)

The Master is able to address up to 255 slaves.

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COMMUNICATION RULES

- The Master handles alone the exchanges : HE decides,
- Repeat the question during an erroneous exchange,
- Consider a slave absent after a time-out,
- A single equipment at the same time in emission, on a line,
- No slave can send of message if he was not invited there,
- Possible side communication if and only if the Master was programmed to receive data and send back them from a slave to the other one.

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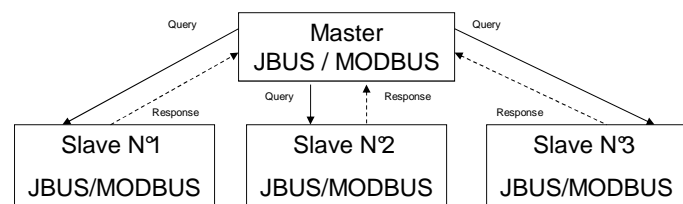
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TREATED ON A HIERARCHICAL BASIS STUCTURE

One Master, several slaves




```

graph TD
    Master["Master  
JBUS / MODBUS"]
    Slave1["Slave N°1  
JBUS/MODBUS"]
    Slave2["Slave N°2  
JBUS/MODBUS"]
    Slave3["Slave N°3  
JBUS/MODBUS"]
    Master -- Query --> Slave1
    Master -- Query --> Slave2
    Master -- Query --> Slave3
    Slave1 -. Response .-> Master
    Slave2 -. Response .-> Master
    Slave3 -. Response .-> Master
  
```

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FRAME JBUS / MODBUS

Slave #	Function Code	Data Field	CRC16
1 Byte	1 Byte	n Bytes	2 Bytes

Slave # : 0 to 255 (0 = general broadcast for writing functions only).


Function Code : Indicates the exchange type (see next pages)

Data Field : Information field containing the parameters linked to the function : word address, word value, number of words...

CRC16 : Word used to detect transmission errors (Cyclic Redundary Check).

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FRAME : The Query ?


It contains a Function Code indicating to the sent addressed slave, which type of action is asked. The data contain additional information which the slave needs to execute this function.

The CRC16 allows the slave to make sure of the completeness of the contents of the question.

Slave #	Function Code	Data Field	CRC16
1 Byte	1 Byte	n Bytes	2 Bytes

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FRAME : The Response

If an error appears, function code is modified to indicate that the answer is an error answer.

The data contain then an exception code identifying the error type.

The control field allows the master to confirm that the message is valid.

Slave #	Function Code	Exception Code	CRC16
1 Byte	1 Byte	n Bytes	2 Bytes

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FRAME : The coding

Two type of code can be used to communicate on a Modbus network. All the present equipments on the network must be configured according to the same type.

ASCII Type : each component of the frame is coded with #2 ASCII charaters (2 x 8 bits)

RTU Type (Remote Terminal Unit) : each byte composing a frame is coded with #2 hexadecimal characters (2 x 4 bits). The maximal size of the data is 256 bytes.

The RTU mode allows a higher data flow for the same transmission speed.

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MODBUS FUNCTIONS

The MODBUS protocol rests on predefined functions, associated with a particular code (on 1 byte = from 0 to 255), which we can classify in 3 families :


1.- Data access : these functions allow to reach in reading and/or writing mode, bits, words or files of an ModBus equipment.

2.- Diagnosis : these functions allow to make some diagnose on a ModBus equipment.

3.- Others : These functions allow the encapsulation of the MODBUS protocol on another one (ex: Can open)

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DATA TRANSFERT

The specifications depend on manufacturers

- Attention on the order of transmission of bytes or words (in the case of data on 32 bits).
- There is no a universal rule, you have to know how your Data Logger is waiting for the expected data, that it is supposed to be able to understand.

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MJBUS CHROMATOSUD Driver Overview

- ✓ The MJBUS driver is a program that realizes the interface between the software Vistachrom, that pilots the chromatograph and the ModBus (RTU mode) or Jbus communication protocol. This driver uses the Vistachrom real time database (RTDB or BDTR : Base de Donnée Temps Réel, in french).
- ✓ This is a shared memory area that contains amongst other things, the latest results received from the instruments.

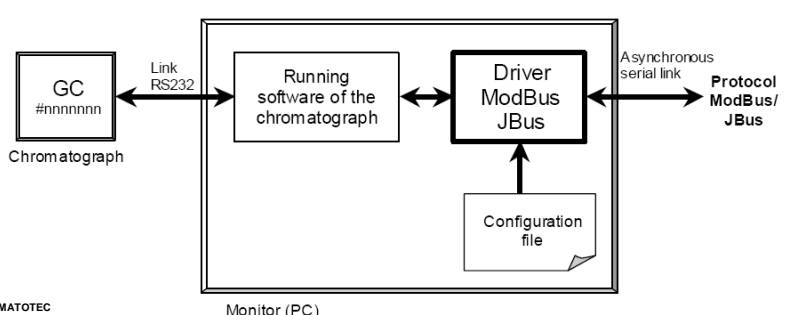
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MJBUS CHROMATOSUD Driver Overview




```

graph LR
    GC[GC #nnnnnnn  
Chromatograph] -- "Link RS232" --> Monitor
    subgraph Monitor_PC [Monitor (PC)]
        direction TB
        Running[Running software of the chromatograph] <--> Driver[Driver ModBus JBus]
        Config[Configuration file] --> Driver
    end
    Driver -- "Asynchronous serial link" --> Protocol[Protocol ModBus/ JBus]
  
```

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MJBUS CHROMATOSUD Driver Overview

✓ This driver can run with several slave numbers if necessary. Currently it implements, the following 4 functions of the protocol:

- Reading of n words.
- Writing of a word
- Simultaneous writing of several words

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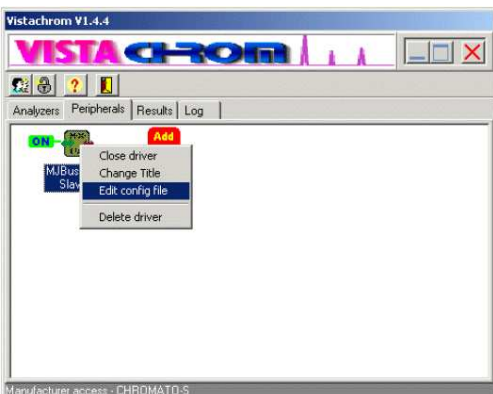


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MJBUS CHROMATOSUD Driver Configuration : Mapping

✓ Before using the MJBUS driver, the configuration file must be checked and edited. To do it you have to:

- You should have a configured file, let's see what it looks like. The configuration file will define what we call the MAPPING of MJBUS driver.



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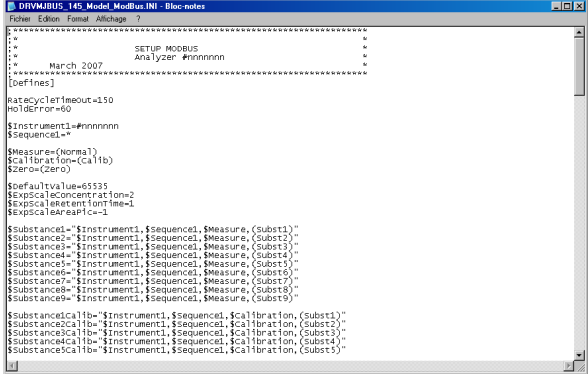


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MJBUS CHROMATOSUD Driver Configuration : Defines

✓ These details are divided in several sections. These sections begin with a name of section, this name is framed with brackets.

- The first section called [Defines] allows to parameter a few functions and to define the symbolic constant that will be used in the other sections in order to make the writing or the configuration easier.



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MJBUS CHROMATOSUD Driver Configuration : Defines

✓ SECTION CONFIGURATION [DEFINES] : This section can modify the value of two parameters and to define the characters string symbolic constants.

- RATE CYCLE TIME OUT : This parameter indicates the maximum time accepted between two measures series in rate cycle time out (percentage). It defines the maximum allowed delay for the analyser to release its next results.
- DEFINITION OF SYMBOLIC CONSTANTS : In order to make the writing and configuration of definition sections of the Modbus slave mapping ([Slave n]) easy, we can define the symbolic constants that stand for a string.

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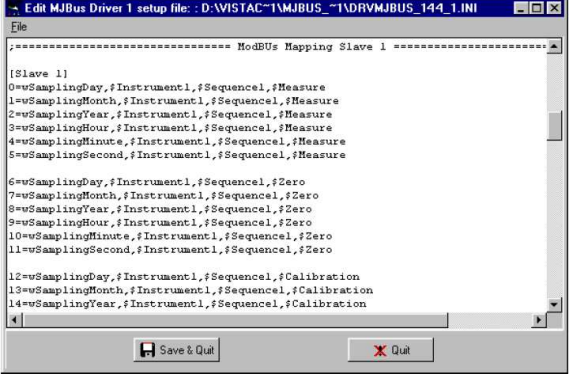


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MJBUS CHROMATOSUD Driver

Configuration : Slaves overview

- The following sections allow to define the ModBus / Jbus registers « mapping » of the different slaves necessary to the setting up. The name of these sections is in the form [Slave n] where n is the ModBus/Jbus slave number. You can define as many slave as necessary for you configuration but generally one slave is sufficient.



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MJBUS CHROMATOSUD Driver

Configuration : Slaves Mapping definition1

- **Important note** : the register numbering varies between Modbus and Jbus protocol, despite the other parts are identical. The Modbus protocol starts the register numbering with 1 (or 40001) and the Jbus starts with 0. Depending of the Modbus client, this may leads that the register address may be 1 shifted and one should take in account when building request.
- Each line of this section defines a field in the slave register space. According to its value type, a field can use one or more registers to fit.

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MJBUS CHROMATOSUD Driver

Configuration : Slaves Mapping definition2

- The syntax of these lines is the following : Address=FieldType, parm1, parm2...
- Example :


```
100=wConcentration,#5411002,Seq541,Mth541_1,Toluene,2,65535
```
- Assigns to register address 100, the integer of the toluene. And this on the condition that the concentration has been obtained with the Mth541_1 method of the Seq541 sequence running on the #5411002 instrument. The default value, without any measurement in the allotted time, is 65535.

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MJBUS CHROMATOSUD Driver

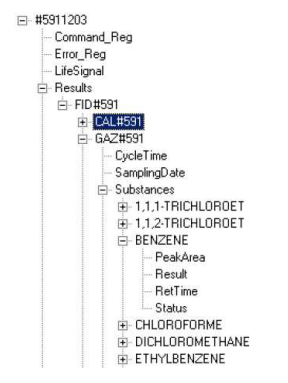
RTDB structure

TYPE STRUCTURE OF A KEY INSTRUMENT IN THE RTDB


Example :

```
#5911203.FID#591.GAZ#591.Substances.BENZENE.Result
```

shows the syntax that must be used for accessing to the Benzene concentration measured by the instrument #5911203 by using the method GAZ#591 of the sequence FID#591. The names of the keys constituting the access path must be separated with a point



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MJBUS CHROMATOSUD Driver

Configuration : Slaves Mapping definition3

- LIST OF DIFFERENT FIELD TYPES

File type	Description	Size	Type
sConstant	Inserts a fix text	-	String
sDate	Inserts the PC date (in the form of a string)	4	String
sTime	Inserts the PC time (in the form of a string)	3	String
sSamplingDate	Inserts the date of the latest sampling achieved with a data method (in the form of a string)	4	String
sSamplingTime	Inserts the hour of the latest sampling achieved with a data method (in the form of a string)	3	String
wSamplingDay	Inserts the date of the latest sampling achieved with a data (in the form of a integer) .	1	Word
wSamplingMonth	Inserts the month of the latest sampling achieved with a data method (in the form of a integer) .	1	Word
wSamplingYear	Inserts the year of the latest sampling achieved with a data method (in the form of a integer) .	1	Word
wSamplingHour	Inserts the hour of the latest sampling achieved with a data method (in the form of a integer) .	1	Word
wSamplingMinute	Inserts the minutes of the latest sampling achieved with a data method (in the form of a integer) .	1	Word
wSamplingSecond	Inserts the seconds of the latest sampling achieved with a data method (in the form of a integer) .	1	Word
fSamplingDay	Inserts the day of the latest sampling achieved with a data method (in the form of a float) .	2	Float
fSamplingMonth	Inserts the month of the latest sampling achieved with a data method (in the form of a float) .	2	Float
fSamplingYear	Inserts the year of the latest sampling achieved with a data method (in the form of a float) .	2	Float

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MJBUS CHROMATOSUD Driver

Configuration : Slaves Mapping definition4

- LIST OF DIFFERENT FIELD TYPES

fSamplingYear	Inserts the year of the latest sampling achieved with a data method (in the form of a float)	2	Float
fSamplingHour	Inserts the hour of the latest sampling achieved with a data method (in the form of a float).	2	Float
fSamplingMinute	Inserts the minutes of the latest sampling achieved with a data method (in the form of a float).	2	Float
fSamplingSecond	Inserts the seconds of the latest sampling achieved with a data method (in the form of a float) .	2	Float
wConcentration	Inserts the concentration of a substance (in the form of a integer)	1	Word
wRetentionTime	Inserts the retention time of a substance (in the form of a integer)	1	Word
wPicArea	Inserts the peak surface of a substance (in the form of a integer).	1	Word
lConcentration	Inserts the substance concentration (in the form of a integer)	2	Long
lRetentionTime	Inserts the retention time of a substance (in the form of a long integer)	2	Long
lPicArea	Inserts the peak surface of a substance (in the form of a long integer)	2	Long
fConcentration	Inserts the substance concentration (in the form of a float)	2	Float
fRetentionTime	Inserts the retention time of a substance (in the form of a float)	2	Float
fPicArea	Inserts the surface of a substance peak (in the form of a float)	2	Float
a2Concentration	Inserts the substance concentration (in the form of a float number with 2 characters identifying the substance before)	3	CodeSubst +Float
a2RetentionTime	Inserts the retention time of a substance (in the form of a decimal float number with two characters identifying the substance before)	3	CodeSubst +Float
a2PicArea	Inserts the surface of the substance peak (in the form of a float number with two characters identifying the substance before).	3	CodeSubst +Float

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MJBUS CHROMATOSUD Driver

Configuration : Slaves Mapping definition5

• LIST OF DIFFERENT FIELD TYPES

Command	Inserts a order register allowing to act on the instrument (log on/log off the cycle, calibration, zero)	2	Reg. 32b
Status	Inserts a state register reporting the instrument state (log on/log off, run/standby)	4	Reg. 64b
Default	Inserts a default register reporting some error codes emitted by the instrument	2	Reg. 32b
word	Inserts a RTDB data (non signed integer of 16 bits)	1	Word
int	Inserts a RTDB data (signed integer of 16 bits)	1	Int
long	Inserts a RTDB data (signed integer of 32 bits)	2	Long
float	Inserts a RTDB data (floating comma integer)	2	Float
wLifeSignal	Inserts the « live signal » of an instrument.. In the RTDB it means to the « LifeSignal » rubric value of the instrument key (ex : #5000404.LifeSignal). This value is increased roughly one time by second..	1	Word
wResultsCount	Inserts the « results counter » of an instrument. In the RTDB, it means to the « ResultsCount » rubric value of the instrument key (ex : #5000404.ResultsCount). This value is increased each time when the instrument supplies new results..	1	Word

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MJBUS CHROMATOSUD Driver

Declaration of Instrument register fields1

Command register

Command N°	Name	Action
1	LogOn	Asks to Vistachrom to connect to the instrument
2	LogOff	Asks to Vistachrom to disconnect to the instrument
3	Start	Asks to Vistachrom to start up the sequence
4	Stop	Asks to Vistachrom to stop the current sequences
5	Calib	Asks to Vistachrom to insert a calibration method
6	Zero	Asks to Vistachrom to insert a zero method
7	Mth1	Asks to Vistachrom to insert the method 1
8	Mth2	Asks to Vistachrom to insert the method 2
9	Mth3	Asks to Vistachrom to insert the method 3
10	Mth4	Asks to Vistachrom to insert the method 4
11	Mth5	Asks to Vistachrom to insert the method 5
12	Mth6	Asks to Vistachrom to insert the method 6

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MJBus CHROMATOSUD Driver

Declaration of Instrument register fields2

State Register

Bit number of the internal state	Meaning
33	Log On -> The instrument is connected to Vistachrom
34	Run -> The instrument executes a sequence
35	Wait -> The instrument is on the waiting phase (above all useful when it is in the « slave » mode
36	Synch -> th instrument is in progress of synchronisation (ex : waiting for the whole minute for starting up a new method))
37	Calib -> The latest results obtaines come from the calibration method.
38	Zero -> The latest results obtained come from the zero method.
39	ResultMth1 -> the latest obtained results come from the method 1
40	ResultMth2 -> The latest obtained results come from the method 2
41	ResultMth3 -> The latest obtained results come from the method 3
42	ResultMth4 -> The latest obtained results come from the method 4
43	ResultMth5 -> The latest obtained results come from the method 5
44	ResultMth6 -> The latest obtained results come from the method 6
45	SamplingMth1 -> the sampling phase of the method 1 is pending
46	SamplingMth2 -> the sampling phase of the method 2 is pending
47	SamplingMth3 -> The sampling phase of the method 3 is pending
48	SamplingMth4 -> The sampling phase of the method 4 is pending
49	SamplingMth5 -> The sampling phase of the method 5 is pending
50	SamplingMth6 -> The sampling phase of the method 6 is pending
51	TimeOut -> the instrument has not returned any results in the given time.
52	Reserved
.....
64	Reserved

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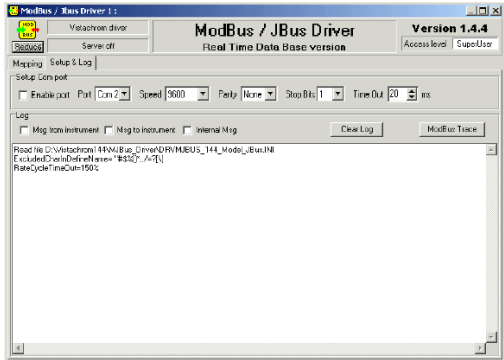
MJBus CHROMATOSUD Driver

INTERFACE DRIVER USER1


THE « SETUP & LOG » TAB

THE “ SETUP COM PORT” FRAME

It allows to setup the asynchronous serial communication port.



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MJBUS CHROMATOSUD Driver

INTERFACE DRIVER USER2


THE « SETUP & LOG » TAB

THE FRAME « LOG »

The display area shows the actions executed by the driver.

- The configuration file reading (DrvMJBUS_14x_1.INI)
- The initialization of RateCycleTimeOut
- The displayed errors occurred when the configuration file is interpreted.

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MJBUS CHROMATOSUD Driver


INTERFACE DRIVER USER3

THE « SETUP & LOG » TAB

THE FRAME « LOG »

The button « **ModBus Trace** » opens up a window that displays the detail of the ModBus frames in the hexadecimal form exchanged between the driver and the distant Modbus client

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MJBus CHROMATOSUD Driver

INTERFACE DRIVER USER4

THE « MAPPING » TAB

This tab visualizes the « mapping » of different ModBus / JBus slaves run by the driver. This mapping is under the form of a table. Each line of this one represents a field in the slave register space

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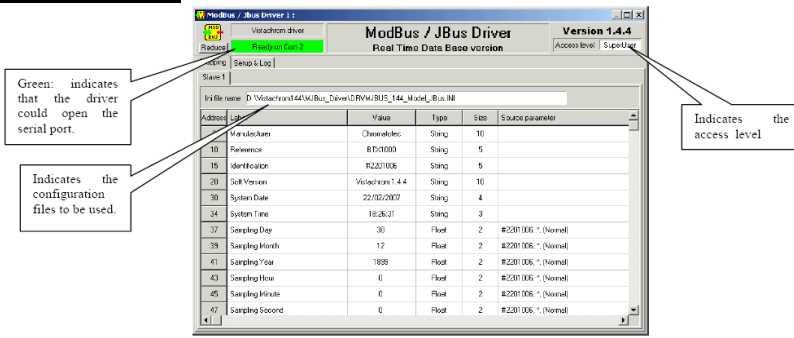


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MJBus CHROMATOSUD Driver

INTERFACE DRIVER USER4

THE « MAPPING » TAB




Green: indicates that the driver could open the serial port.

Indicates the configuration files to be used.

Indicates the access level

Address	Label	Value	Type	Size	Source parameter
0	Manufacturer	Chemisches	String	10	
10	Reference	8703000	String	5	
15	Identification	8201008	String	5	
20	Software version	Modbus 1.4.4	String	10	
30	System date	22/02/2007	String	4	
34	System time	18:26:31	String	3	
37	Sampling Day	30	Float	2	#2201.006 ° (Normal)
39	Sampling Month	12	Float	2	#2201.006 ° (Normal)
41	Sampling Year	1888	Float	2	#2201.006 ° (Normal)
43	Sampling Hour	0	Float	2	#2201.006 ° (Normal)
45	Sampling Minute	0	Float	2	#2201.006 ° (Normal)
47	Sampling Second	0	Float	2	#2201.006 ° (Normal)

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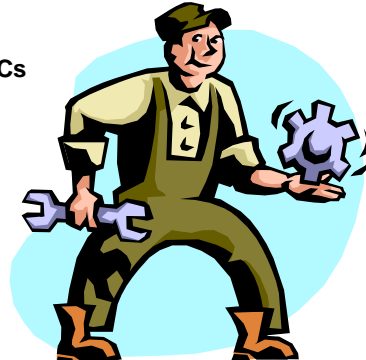
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MJBus CHROMATOSUD Driver

RUNNING MJBUS DRIVER

- Now let's practice : hands on the GCs



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